WHAT IS CLAIMED IS:

1. An image processing apparatus which multiplexes noise on multilevel image data containing at least a luminance component as a main component, thereby embedding visible additional information with a noise-multiplexed distribution, comprising:

input means for inputting, as the additional information, information representing whether or not to multiplex noise for each pixel;

determination means for determining on the basis of the additional information whether a pixel of interest in the multilevel image data is located at a position where noise is to be multiplexed;

luminance value calculation means for, when said determination means determines that the pixel of interest is located at the position where noise is to be multiplexed, calculating an addition luminance value to be added to the pixel of interest on the basis of a luminance value of a neighboring region near the pixel of interest; and

addition means for adding the calculated addition luminance value to a luminance value of the pixel of interest.

2. The apparatus according to claim 1, wherein said luminance value calculation means comprises

first conversion means for converting data of the neighboring region into a lightness value,

change amount calculation means for calculating a lightness change amount for the neighboring region on the basis of key information for multiplexing reversible noise on the pixel of interest and the luminance value of the neighboring region,

lightness addition means for adding the calculated lightness change amount to the lightness value converted by said first conversion means,

second conversion means for converting the lightness value obtained by said lightness addition means into a luminance value, and

means for calculating, as the addition luminance value, a difference between the luminance value obtained by said second conversion means and the luminance value of the neighboring region.

3. The apparatus according to claim 2, wherein said change amount calculation means includes means for determining a sign to be changed on the basis of the luminance or lightness value of the neighboring region.

4. The apparatus according to claim 2, wherein the key information includes intensity information of noise to be embedded, a random number key for generating noise, and a noise amplitude.

5. The apparatus according to claim 1, wherein the information which is input by said input means and represents whether or not to multiplex noise for each pixel includes information expressed by a multilevel

value, and when noise is multiplexed, stores a visible intensity level for multiplexing.

6. The apparatus according to claim 1, wherein in a case where a luminance value added by said addition means exceeds an expressible grayscale range, the addition luminance value is not added to a corresponding pixel, and the information representing whether or not to multiplex noise for a position corresponding to the additional information is changed not to multiplex noise.

7. An image processing apparatus which removes visible additional information from multilevel image data in which noise is reversibly embedded to multiplex the visible additional information, comprising:

input means for inputting, as the additional information, information representing whether or not to multiplex noise for each pixel;

determination means for determining on the basis of the additional information whether a pixel of interest in the multilevel image data is located at a position where noise is multiplexed;

addition luminance value calculation means for, when said determination means determines that the pixel of interest is located at the position where noise is multiplexed, calculating an addition luminance value added to the pixel of interest on the basis of a luminance of a neighboring region near the pixel of

interest where removal processing has been completed; and

subtraction means for subtracting the calculated luminance value from a luminance value of the pixel of interest.

8. An image processing apparatus which multiplexes noise on multilevel image data comprised of a plurality of color components, thereby embedding visible additional information with a noise-multiplexed distribution, comprising:

input means for inputting, as the additional information, information representing whether or not to multiplex noise for each pixel;

determination means for determining on the basis of the additional information whether a pixel of interest in the multilevel image data is located at a position where noise is to be multiplexed;

addition pixel value calculation means for, when said determination means determines that the pixel of interest is located at the position where noise is to be multiplexed, calculating an addition pixel value to be added to the plurality of color components of the pixel of interest on the basis of a luminance value of a neighboring region near the pixel of interest; and

addition means for adding the calculated addition pixel value to a pixel value of the pixel of interest.

9. The apparatus according to claim 8, wherein said

addition pixel value calculation means comprises

means for calculating a luminance value from a pixel value of the neighboring region,

first conversion means for converting the luminance value into a lightness value,

change amount calculation means for calculating a lightness change amount for the neighboring region on the basis of key information for multiplexing reversible noise on the pixel of interest and the luminance value of the neighboring region,

lightness addition means for adding the calculated lightness change amount to the lightness value converted by said first conversion means,

second conversion means for converting the lightness value obtained by said lightness addition means into a luminance value,

third conversion means for converting the luminance value obtained by said second conversion means into a plurality of pixel values, and

means for calculating, as the addition pixel value, a difference between the pixel value obtained by said third conversion means and the pixel value of the neighboring region.

10. An image processing apparatus which removes visible additional information from multilevel image data in which noise is reversibly embedded to multiplex the visible additional information, comprising:

input means for inputting, as the additional information, information representing whether or not to multiplex noise for each pixel;

determination means for determining on the basis of the additional information whether a pixel of interest in the multilevel image data is located at a position where noise is multiplexed;

addition pixel value calculation means for, when said determination means determines that the pixel of interest is located at the position where noise is multiplexed, calculating an addition pixel value added to the pixel of interest on the basis of a luminance of a neighboring region near the pixel of interest where removal processing has been completed; and

subtraction means for subtracting the calculated pixel value from a pixel value of the pixel of interest.

11. An image processing method of multiplexing noise on multilevel image data containing at least a luminance component as a main component, thereby embedding visible additional information with a noise-multiplexed distribution, comprising:

an input step of inputting, as the additional information, information representing whether or not to multiplex noise for each pixel;

a determination step of determining on the basis of the additional information whether a pixel of

interest in the multilevel image data is located at a position where noise is to be multiplexed;

a luminance value calculation step of, when the pixel of interest is determined in the determination step to be located at the position where noise is to be multiplexed, calculating an addition luminance value to be added to the pixel of interest on the basis of a luminance value of a neighboring region near the pixel of interest; and

an addition step of adding the calculated addition luminance value to a luminance value of the pixel of interest.

12. An image processing method of removing visible additional information from multilevel image data in which noise is reversibly embedded to multiplex the visible additional information, comprising:

an input step of inputting, as the additional information, information representing whether or not to multiplex noise for each pixel;

a determination step of determining on the basis of the additional information whether a pixel of interest in the multilevel image data is located at a position where noise is multiplexed;

an addition luminance value calculation step of, when the pixel of interest is determined in the determination step to be located at the position where noise is multiplexed, calculating an addition luminance

value added to the pixel of interest on the basis of a luminance of a neighboring region near the pixel of interest where removal processing has been completed; and

a subtraction step of subtracting the calculated luminance value from a luminance value of the pixel of interest.

13. An image processing method of multiplexing noise on multilevel image data comprised of a plurality of color components, thereby embedding visible additional information with a noise-multiplexed distribution, comprising:

an input step of inputting, as the additional information, information representing whether or not to multiplex noise for each pixel;

a determination step of determining on the basis of the additional information whether a pixel of interest in the multilevel image data is located at a position where noise is to be multiplexed;

an addition pixel value calculation step of, when the pixel of interest is determined in the determination step to be located at the position where noise is to be multiplexed, calculating an addition pixel value to be added to the plurality of color components of the pixel of interest on the basis of a luminance value of a neighboring region near the pixel of interest; and

an addition step of adding the calculated addition pixel value to a pixel value of the pixel of interest.

14. An image processing method of removing visible additional information from multilevel image data in which noise is reversibly embedded to multiplex the visible additional information, comprising:

an input step of inputting, as the additional information, information representing whether or not to multiplex noise for each pixel;

a determination step of determining on the basis of the additional information whether a pixel of interest in the multilevel image data is located at a position where noise is multiplexed;

an addition pixel value calculation step of, when the pixel of interest is determined in the determination step to be located at the position where noise is multiplexed, calculating an addition pixel value added to the pixel of interest on the basis of a luminance of a neighboring region near the pixel of interest where removal processing has been completed; and

a subtraction step of subtracting the calculated pixel value from a pixel value of the pixel of interest.

15. A computer program functioning as an image processing apparatus which multiplexes noise on

multilevel image data containing at least a luminance component as a main component, thereby embedding visible additional information with a noise-multiplexed distribution, functioning as:

input means for inputting, as the additional information, information representing whether or not to multiplex noise for each pixel;

determination means for determining on the basis of the additional information whether a pixel of interest in the multilevel image data is located at a position where noise is to be multiplexed;

luminance value calculation means for, when said determination means determines that the pixel of interest is located at the position where noise is to be multiplexed, calculating an addition luminance value to be added to the pixel of interest on the basis of a luminance value of a neighboring region near the pixel of interest; and

addition means for adding the calculated addition luminance value to a luminance value of the pixel of interest.

16. A computer-readable storage medium storing a computer program defined in claim 15.

17. A computer program functioning as an image processing apparatus which removes visible additional information from multilevel image data in which noise is reversibly embedded to multiplex the visible

additional information, functioning as:

input means for inputting, as the additional information, information representing whether or not to multiplex noise for each pixel;

determination means for determining on the basis of the additional information whether a pixel of interest in the multilevel image data is located at a position where noise is multiplexed;

addition luminance value calculation means for, when said determination means determines that the pixel of interest is located at the position where noise is multiplexed, calculating an addition luminance value added to the pixel of interest on the basis of a luminance of a neighboring region near the pixel of interest where removal processing has been completed; and

subtraction means for subtracting the calculated luminance value from a luminance value of the pixel of interest.

18. A computer-readable storage medium storing a computer program defined in claim 17.

19. A computer program functioning as an image processing apparatus which multiplexes noise on multilevel image data comprised of a plurality of color components, thereby embedding visible additional information with a noise-multiplexed distribution, functioning as:

input means for inputting, as the additional information, information representing whether or not to multiplex noise for each pixel;

determination means for determining on the basis of the additional information whether a pixel of interest in the multilevel image data is located at a position where noise is to be multiplexed;

addition pixel value calculation means for, when said determination means determines that the pixel of interest is located at the position where noise is to be multiplexed, calculating an addition pixel value to be added to the plurality of color components of the pixel of interest on the basis of a luminance value of a neighboring region near the pixel of interest; and

addition means for adding the calculated addition pixel value to a pixel value of the pixel of interest.

20. A computer-readable storage medium storing a computer program defined in claim 19.

21. A computer program functioning as an image processing apparatus which removes visible additional information from multilevel image data in which noise is reversibly embedded to multiplex the visible additional information, functioning as:

input means for inputting, as the additional information, information representing whether or not to multiplex noise for each pixel;

determination means for determining on the basis

of the additional information whether a pixel of interest in the multilevel image data is located at a position where noise is multiplexed;

addition pixel value calculation means for, when said determination means determines that the pixel of interest is located at the position where noise is multiplexed, calculating an addition pixel value added to the pixel of interest on the basis of a luminance of a neighboring region near the pixel of interest where removal processing has been completed; and

subtraction means for subtracting the calculated pixel value from a pixel value of the pixel of interest.

22. A computer-readable storage medium storing a computer program defined in claim 21.

23. An image processing apparatus which converts multilevel image data containing at least a luminance component as a main component into frequency component data for each pixel block of a predetermined size to compression-code the multilevel image data, and multiplexes noise on the multilevel image to embed visible additional information with a noise-multiplexed distribution, comprising:

input means for inputting, as the additional information, information representing whether or not to multiplex noise for each pixel block of the predetermined size;

determination means for determining on the basis of the additional information whether a pixel block of interest in the multilevel image data is located at a position where noise is to be multiplexed;

luminance value calculation means for, when said determination means determines that the pixel block of interest is located at the position where noise is to be multiplexed, referring to a pixel block near the pixel block of interest and calculating an addition luminance value to be added to a low frequency component of the block of interest; and

addition means for adding the calculated addition luminance value to a luminance value of the low frequency component of the pixel block of interest.

24. An image processing apparatus which removes visible additional information from multilevel image data in which noise is reversibly embedded to multiplex the visible additional information, comprising:

input means for inputting, as the additional information, information representing whether or not to multiplex noise for each pixel block of a predetermined size;

determination means for determining on the basis of the additional information whether a pixel block of interest in the multilevel image data is located at a position where noise is multiplexed;

luminance value calculation means for, when said

determination means determines that the pixel block of interest is located at the position where noise is multiplexed, referring to a pixel block near the pixel block of interest and calculating an addition luminance value added to a low frequency component of the block of interest; and

reconstruction means for subtracting the calculated addition luminance value from the low frequency component of the pixel block of interest, thereby reconstructing a state before multiplexing.

25. An image processing method of converting multilevel image data containing at least a luminance component as a main component into frequency component data for each pixel block of a predetermined size to compression-code the multilevel image data, and multiplexing noise on the multilevel image to embed visible additional information with a noise-multiplexed distribution, comprising:

an input step of inputting, as the additional information, information representing whether or not to multiplex noise for each pixel block of the predetermined size;

a determination step of determining on the basis of the additional information whether a pixel block of interest in the multilevel image data is located at a position where noise is to be multiplexed;

a luminance value calculation step of, when the

pixel block of interest is determined in the determination step to be located at the position where noise is to be multiplexed, referring to a pixel block near the pixel block of interest and calculating an addition luminance value to be added to a low frequency component of the block of interest; and

an addition step of adding the calculated addition luminance value to a luminance value of the low frequency component of the pixel block of interest.

26. An image processing method of removing visible additional information from multilevel image data in which noise is reversibly embedded to multiplex the visible additional information, comprising:

an input step of inputting, as the additional information, information representing whether or not to multiplex noise for each pixel block of a predetermined size;

a determination step of determining on the basis of the additional information whether a pixel block of interest in the multilevel image data is located at a position where noise is multiplexed;

a luminance value calculation step of, when the pixel block of interest is determined in the determination step to be located at the position where noise is multiplexed, referring to a pixel block near the pixel block of interest and calculating an addition luminance value added to a low frequency component of

the block of interest; and

a reconstruction step of subtracting the calculated addition luminance value from the low frequency component of the pixel block of interest, thereby reconstructing a state before multiplexing.

27. A computer program functioning as an image processing apparatus which converts multilevel image data containing at least a luminance component as a main component into frequency component data for each pixel block of a predetermined size to compression-code the multilevel image data, and multiplexes noise on the multilevel image to embed visible additional information with a noise-multiplexed distribution, functioning as:

input means for inputting, as the additional information, information representing whether or not to multiplex noise for each pixel block of the predetermined size;

determination means for determining on the basis of the additional information whether a pixel block of interest in the multilevel image data is located at a position where noise is to be multiplexed;

luminance value calculation means for, when said determination means determines that the pixel block of interest is located at the position where noise is to be multiplexed, referring to a pixel block near the pixel block of interest and calculating an addition

luminance value to be added to a low frequency component of the block of interest; and

addition means for adding the calculated addition luminance value to a luminance value of the low frequency component of the pixel block of interest.

28. A computer-readable storage medium storing a computer program defined in claim 27.

29. A computer program functioning as an image processing apparatus which removes visible additional information from multilevel image data in which noise is reversibly embedded to multiplex the visible additional information, functioning as:

input means for inputting, as the additional information, information representing whether or not to multiplex noise for each pixel block of a predetermined size;

determination means for determining on the basis of the additional information whether a pixel block of interest in the multilevel image data is located at a position where noise is multiplexed;

luminance value calculation means for, when said determination means determines that the pixel block of interest is located at the position where noise is multiplexed, referring to a pixel block near the pixel block of interest and calculating an addition luminance value added to a low frequency component of the block of interest; and

reconstruction means for subtracting the calculated addition luminance value from the low frequency component of the pixel block of interest, thereby reconstructing a state before multiplexing.

30. A computer-readable storage medium storing a computer program defined in claim 29.

31. An image processing apparatus which multiplexes noise on multilevel image data to embed visible additional information with a noise-multiplexed distribution, comprising:

input means for inputting, as the additional information, information representing whether or not to multiplex noise for each pixel;

determination means for determining on the basis of the additional information whether a pixel of interest in the multilevel image data is located at a position where noise is to be multiplexed;

addition pixel value calculation means for, when said determination means determines that the pixel of interest is located at the position where noise is to be multiplexed, calculating an addition pixel value to be added to the pixel of interest;

addition means for adding the calculated addition pixel value to a pixel value of the pixel of interest;

discrimination means for discriminating whether the added pixel value exceeds a predetermined range; and

additional information change means for, when said discrimination means discriminates that the added pixel value exceeds the predetermined range, replacing the added pixel value with the pixel value of the pixel of interest, and replacing information representing that noise at a position corresponding to the additional information is to be multiplexed into information representing that noise is not multiplexed.

32. An image processing method of multiplexing noise on multilevel image data to embed visible additional information with a noise-multiplexed distribution, comprising:

an input step of inputting, as the additional information, information representing whether or not to multiplex noise for each pixel;

a determination step of determining on the basis of the additional information whether a pixel of interest in the multilevel image data is located at a position where noise is to be multiplexed;

an addition pixel value calculation step of, when the pixel of interest is determined in the determination step to be located at the position where noise is to be multiplexed, calculating an addition pixel value to be added to the pixel of interest;

an addition step of adding the calculated addition pixel value to a pixel value of the pixel of interest;

a discrimination step of discriminating whether the added pixel value exceeds a predetermined range; and

an additional information change step of, when the added pixel value is discriminated in the discrimination step to exceed the predetermined range, replacing the added pixel value with the pixel value of the pixel of interest, and replacing information representing that noise at a position corresponding to the additional information is to be multiplexed into information representing that noise is not multiplexed.

33. A computer program functioning as an image processing apparatus which multiplexes noise on multilevel image data to embed visible additional information with a noise-multiplexed distribution, functioning as:

input means for inputting, as the additional information, information representing whether or not to multiplex noise for each pixel;

determination means for determining on the basis of the additional information whether a pixel of interest in the multilevel image data is located at a position where noise is to be multiplexed;

addition pixel value calculation means for, when said determination means determines that the pixel of interest is located at the position where noise is to be multiplexed, calculating an addition pixel value to

be added to the pixel of interest;

addition means for adding the calculated addition pixel value to a pixel value of the pixel of interest;

discrimination means for discriminating whether the added pixel value exceeds a predetermined range; and

additional information change means for, when said discrimination means discriminates that the added pixel value exceeds the predetermined range, replacing the added pixel value with the pixel value of the pixel of interest, and replacing information representing that noise at a position corresponding to the additional information is to be multiplexed into information representing that noise is not multiplexed.

34. A computer-readable storage medium storing a computer program defined in claim 33.